Seabed Dynamics in the Adriatic Sea and Western Gulf of Lions

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LONG-TERM GOALS

The ultimate objective of this research program is to obtain a predictive understanding of the physical and biological processes responsible for the formation, alteration and preservation of sedimentary strata on continental margins. The general approach is to use focused field measurements to develop and test hypotheses.

OBJECTIVES

This project is in a transition between completing analyses of results obtained in the Adriatic Sea during FY01-03, and starting new fieldwork in the Gulf of Lions (GOL) in FY05. The Adriatic research has two broad objectives. First, we are testing the idea that river basin size has a first-order impact on the initial distribution and character of strata in the receiving basin. In particular, we hypothesize that large rivers (e.g. Po), in which discharge peaks are decoupled from oceanic conditions, produce thick beds that have large horizontal continuity and significant vertical (i.e., temporal) variation in physical properties. In contrast, small rivers (e.g., Apennine rivers) produce thin beds, which due to subsequent bioturbation have low horizontal continuity and little vertical variability. Second, we are exploring the idea that large-scale spatial variability in sediment erodibility may control accumulation rate patterns in the western Adriatic (Po River to Gargano peninsula).

Our objectives in the Gulf of Lions are to extend, through collaborations with Patricia Wiberg, Tim Milligan and Paul Hill, our studies of sediment erodibility. In this case we are focusing on whether there are cross-shelf gradients of erodibility in the western GOL, and what controls such gradients. In addition, we are deploying a new bottom-boundary layer tripod that will collect high frequency data on sediment porosity, thereby potentially providing important information on temporal and small-scale spatial change in seabed properties.

APPROACH

Our approach in the GOL research is twofold. First, we use a hydraulically dampened gravity corer to collect samples for the sediment erodibility study. This custom-built corer is well suited to collect high-quality cores in a variety of sediment types (e.g., sands and muds). In the laboratory, we use a variety of techniques to collect high-resolution porosity, roughness, textural and biogeochemical (e.g., exocellular polymeric substances, chlorophyll a) data. Second, through DURIP funding we have constructed an autonomous resitivity profiler (ARP). ARP is an extension of an earlier microresitivity

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14. ABSTRACT
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15. SUBJECT TERMS

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profiler that can move in three dimensions and has a data/power endurance of several months. In concert with a stereocamera, bottom altimeter, and Sontek Hydra system (pressure, currents, temperature, salinity and turbidity), the ARP tripod will be deployed at a 28-m site off the Tet River in the western GOL. Besides the collaborators discussed below, personnel on this project included a research technician, Roger Lewis, who supported the PI in the lab and at sea. Roger departed the lab in May 2005. In addition, a graduate student, Andrew Stevens, completed a M.S. degree in mid-November on seabed properties of the western Adriatic margin, and now conducts diverse data analysis on a part time basis (0.2 FTE).

WORK COMPLETED

During FY05, the PI served as co-chief scientist on three separate research cruises in the Gulf of Lions on the RVs Oceanus (October 2004) and Endeavor (February & April, 2005). Activities during those cruises involved the use of the hydraulically dampened gravity corer to collect seabed samples (~ 150 cores) on an across-margin transect off the Tet River, and the deployment and recovery of the ARP tripod at the 28-m buoy site. The tripod deployment had been scheduled for October, but problems involving foreign clearances necessitated a delay to the February-April time period. Laboratory efforts during the year involved image processing of digital x-radiographs from the Po prodelta region, processing shipboard resistivity data collected during each of the GOL cruises, and processing the diverse data sets from the bottom tripod (e.g., Sontek, ARP). In addition to these field and laboratory activities, we have been actively involved in the preparation and revision of a variety of manuscripts (see list below).

RESULTS

Two results are highlighted. First, we have documented an along-margin change in the small-scale grain size and fabric of a readily recognizable – outwardly uniform - unit within the Po 2000 flood deposit. At sites distal to the main mouth of the river, the unit has a bimodal grain size distribution and is characterized by cross laminations. In contrast, immediately offshore the main mouth the unit is a poorly sorted, structureless bed that coarsens upward (Fig. 1). The latter is a diagnostic feature of hyperpycnal flow deposits (Mulder et al. 2001), and, together, with the diversity of other units within the deposit, suggests the Po flood deposit was emplaced during a range of sediment dynamic conditions. The likely reason for this variability is the large size of the Po River basin, which results in a long-duration flood.

Second, the successful ARP deployment, during which over 350 profiles of sediment porosity were obtained, permits meaningful statistical analyses of sub-bottom physical properties. Interestingly, the data indicate a depth-dependent shift in the skewness of the porosity distribution, with positive skewness near the surface and increasingly negative skewness with depth (Fig. 2). The positive skewness at the surface most likely reflects a higher abundance of open biogenic structures within this region, whereas the cause of the negative skewness at depth remains under investigation.

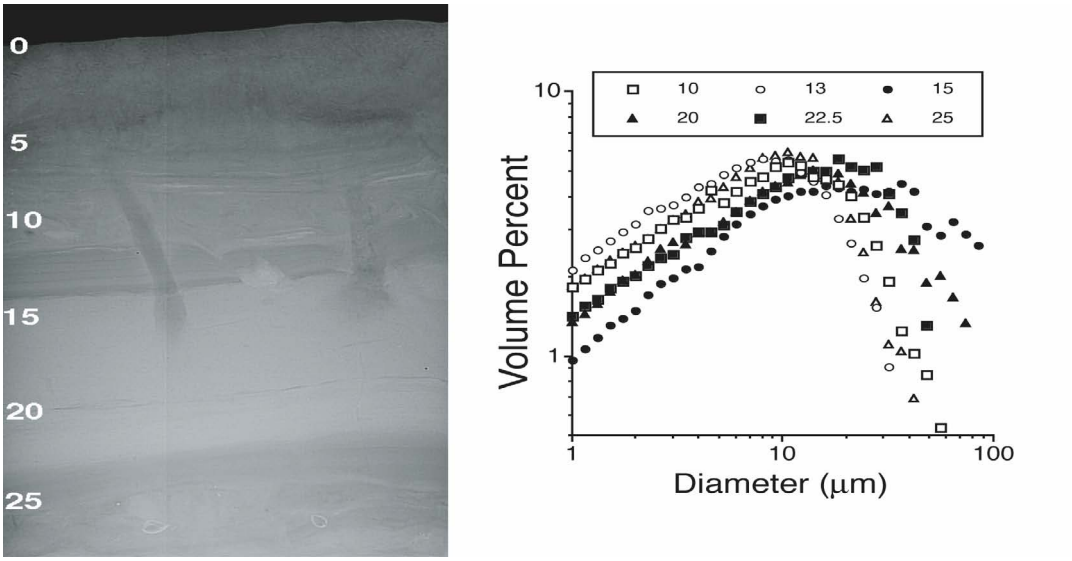

Figure 1. On the left, digital x-radiograph from station ED20 showing a 10-cm thick, x-ray opaque layer within the October 2000 Po River flood deposit. On the right are disaggregated inorganic grain size data that show a coarsening upward trend within the unit, whereby there is an increase in volume percent in the 40 to 100 μm fraction toward the top of the unit (grain size data courtesy of T. Milligan, Bedford Institute of Oceanography).

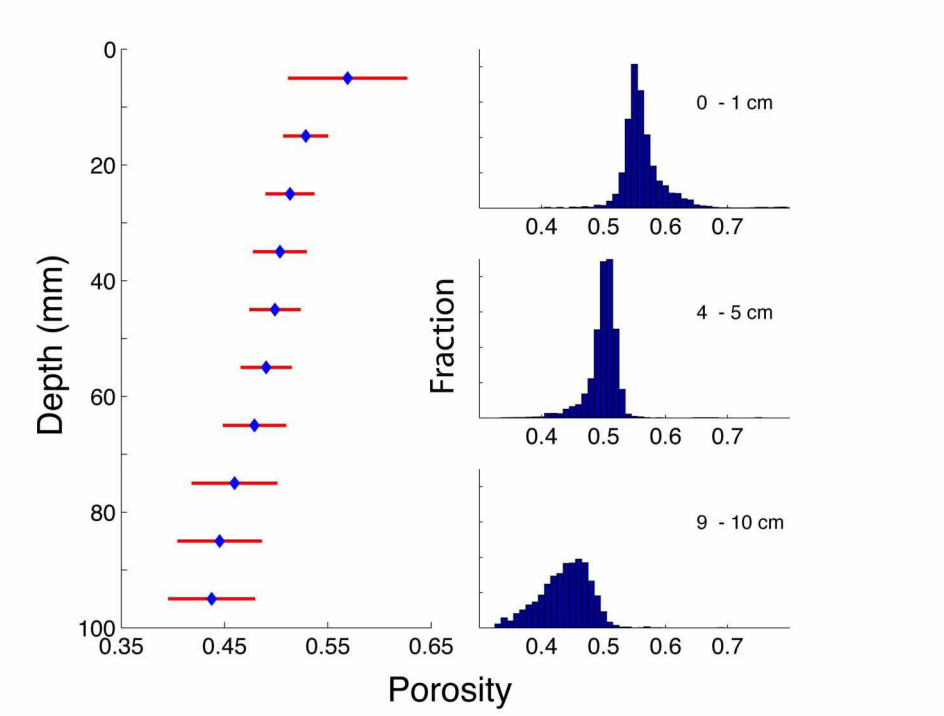

Figure 2. Mean ± standard deviation of porosity vs. depth within the sediment at the 28-m Tet buoy site. Near-surface values are ~0.58 and there is an approximately linear decrease to 0.44 at 9-10 cm. On the right are three panels showing frequency distributions of porosity at 0-1, 4-5 and 9-10 cm. Skewness changes from positive to negative as depth increases.

PUBLICATIONS

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